



Ottawa Hull K1A 0C9

(21) (A1)	2,143,387
(22)	1995/02/24
(43)	1995/09/19

(51) Int.Cl. ⁶ H04N 1/21

(19) (CA) **APPLICATION FOR CANADIAN PATENT (12)**

(54) Data Telemetry System and Method

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(30) (US) 210,887 1994/03/18

(57) 3 Claims

Notice: This application is as filed and may therefore contain an incomplete specification.



Abstract

A data telemetry system and method for use in conjunction with a facsimile machine. The data telemetry system and method include a receiver for receiving an input control signal and a plurality of input data signals, each input data signal representing a pre-determined input parameter, and a memory for storing a pre-defined fax form having a plurality of input parameter fields. The data telemetry system and method also include a processor for processing the input data signals to incorporate the input parameters represented thereby into the input parameter fields of the fax form, and a facsimile machine control signal generator for generating a facsimile machine control signal operative to transmit the fax form via the facsimile machine in response to the input control signal.

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DATA TELEMETRY SYSTEM AND METHOD

Technical Field

5 This invention relates to a data telemetry system and method for use in conjunction with a facsimile machine.

Background Art

10 Each year, equipment errors and out-of-range performance cost a wide variety of industries millions of dollars. On factory floors or at remote locations, such equipment errors and out-of-range performance often remain undetected for extended periods of time, further increasing the monetary costs associated therewith.

15 To overcome such problems, Supervisory Control And Data Acquisition (SCADA) systems may be employed. SCADA systems generally include a master station capable of communication with a number of remote terminal units over dedicated circuits. Typically, the master station periodically requests 20 information (i.e., polls) the remote terminal units for the purpose of observing and controlling the physical plant associated therewith. The frequency of the polling by the master station depends on the nature of the plant involved.

25 In such a fashion, SCADA systems generally perform a variety of functions including monitoring site status and data, transmitting control actions, maintaining historical files, recording events and

preparing periodic reports. As a result of the importance of the master station to SCADA operations, master station functions are typically distributed between at least two computer systems. However, due
5 to the dedicated communication circuits, multiple computer systems and other specialized communications equipment required, as well as the associated control features, the cost of a typical SCADA system can be prohibitive for many industries.

10 Conventional facsimile (fax) machines and fax/modems, while less expensive than a typical SCADA system, are incapable of performing the monitoring and reporting functions necessary to solve the undetected equipment error and out-of-range performance problems
15 detailed above. First, while conventional fax machines can transmit fax "reports", the "data" input for such reports must be presented to most fax machines optically in the form of a printed page. Some fax machines can accept data in the form of audio
20 tones through an attached handset, but an external device is still required to generate the appropriate audio tones in the proper format. Such an external device must also be capable of accepting data from an end device in either a serial or parallel format.

25 Conventional fax/modems would require a computer and compatible applications software to provide the monitoring and reporting capabilities necessary to solve the equipment errors and out-of-range performance problems previously described.
30 Moreover, conventional fax/modems would require additional programming to present the data variables to be contained in the fax report in a sensible

format. To provide such additional requirements to conventional fax/modems would again result in a data telemetry system having a monetary cost prohibitive for many industries.

5 As a result, a need remains for a reliable and inexpensive data telemetry system and method that monitor remote site status and data, and relay such information to a central location. Such a data telemetry system and method would preferably provide
10 monitoring of remote sites to report messages on performance, conditions and errors either instantaneously, on demand, or periodically. In addition, such a data telemetry system and method would also preferably relay such information to one or
15 more central location via a facsimile (fax) machine.

20 In this manner, such a data telemetry system and method would provide the well known monitoring and reporting advantages of traditional SCADA systems, thereby saving the costs associated with undetected equipment errors and out-of-range performance. At the same time, however, such a data telemetry system and method would also avoid the prohibitive costs associated with such traditional SCADA systems and modified facsimile or fax/modem systems, thereby
25 making continuous monitoring and reporting regarding remote locations available for more industrial applications.

Disclosure Of Invention

30 Accordingly, it is the principle object of the present invention to provide an improved data

telemetry system and method for use in conjunction with a facsimile machine for monitoring and reporting concerning a plurality of input parameters.

According to the present invention, then, a data telemetry system and method are provided for use in conjunction with a facsimile machine. More particularly, the data telemetry system comprises means for receiving an input control signal and a plurality of input data signals, each input data signal representing a pre-determined input parameter, and means for storing a pre-defined fax form having a plurality of input parameter fields. The data telemetry system of the present invention further comprises means for processing the input data signals to incorporate the input parameters represented thereby into the input parameter fields of the fax form, and means for generating a facsimile machine control signal operative to transmit the fax form via the facsimile machine in response to the input control signal.

The data telemetry method of the present invention for use in conjunction with a facsimile machine comprises receiving an input control signal and a plurality of input data signals, each input data signal representing a pre-determined input parameter, and storing a pre-defined fax form having a plurality of input parameter fields. The data telemetry method of the present invention further comprises processing the input data signals to incorporate the input parameters represented thereby into the input parameter fields of the fax form, and generating a facsimile machine control signal operative to transmit

the fax form via the facsimile machine in response to the input control signal.

These and other objects, features and advantages will be readily apparent upon consideration 5 of the following detailed description in conjunction with the accompanying drawings.

Brief Description Of Drawings

Figure 1 is a block diagram of the data telemetry system of the present invention for use in conjunction with a facsimile machine. 10

Figure 2 is a block diagram of the data telemetry method of the present invention for use in conjunction with a facsimile machine.

Best Mode For Carrying Out The Invention

As will become apparent, the telemetry system and method of the present invention are first described herein generally. Thereafter, the telemetry system and method are described more specifically with reference to the accompanying drawings. 15

The data telemetry system and method are part of a self contained unit that utilizes a conventional telephone network as the facsimile transmission medium. For that and other reasons explained in greater detail below, the data telemetry system and method of the present invention are adaptable to a wide variety of applications wherein 20 25

data monitoring and reporting concerning remote locations is required.

5 The system and method are capable of sending status reports in the form of a facsimile transmission to a plurality of pre-assigned facsimile machines at various locations. In that regard, the data telemetry system and method of the present invention accept, preferably in a serial format, fax control commands as well as input data in the form of signals. In this 10 regard, the input data signals associated with the system and method may represent multiple input parameters including voltages, currents, pressures, flows, temperatures, and positions. The data telemetry system and method then add code to generate 15 at least one pre-defined fax form from memory. This provides tabulated or otherwise notational fields to place data variables provided by the input data signals in a logical and recognizable order. The data telemetry system and method then convert the data 20 input signals and fax form to facsimile protocol, compress them, and transmit the information to at least one facsimile machine via the telephone network.

25 The data telemetry system and method of the present invention are thus unique from the standpoint that they are a combining of technologies that allows for an inexpensive, self-contained package to perform all of the aforementioned functions. As will be described in greater detail below, the combination of a telephone interface, fax/modem chip set, 30 microprocessor, memory, serial port, power supply and software forms a package that provides more advantages than standard facsimile machine or fax/modem add-on

units, and that provides many of the advantages of traditional SCADA systems at reduced costs.

More specifically, referring now to Figure 1, a block diagram of the data telemetry system of the present invention for use in conjunction with a facsimile machine is shown, denoted generally by reference numeral 10. The system (10) is provided with a serial port (12) for transmitting input data and fax control commands to a microprocessor, or CPU, in the form of an integrated circuit (IC) U1 (14). U21 is an RS232 transceiver associated with serial port (12). U21 converts the RS232 data levels of input signals from an end device (representing various input parameters) to the 5 volt TTL logic levels required by CPU U1 (14).

The telemetry system (10) is designed for communication via at least one analog phone line (not shown). Most residential phone lines, and the outside lines in most businesses, are analog. The system (10) is therefore compatible with most businesses and does not require dedicated communication lines. The system (10) also includes at least one modular phone jack (16). While an RJ-11 phone jack (16) is preferable, the system (10) may also employ different phone jacks (16), including RJ-12, RJ-13, RJ-41S, and RJ-45S. Once again, most businesses have one of these phone jacks (16).

The telemetry system (10) of the present invention also includes a 120 volt AC power supply (not shown). The telemetry system (10) may also include a plurality of viable indicators (not shown).

Such indicators may include a power indicator, data carrier detect indicator, phone line ring indicator, hook indicator (indicating when the system (10) has picked up the phone line), and transmit indicator.

5 The various functions that such indicators represent are described in greater detail below.

Referring still to Figure 1, and as previously indicated, the system (10) preferably includes two modular phone jacks (16) for telephone network interface. Phone jacks (16) are interchangeable since they electrically go to the same point. The difference being separate fusing, filtering, and resistive current limit. Such circuitry is represented by filter and power limit blocks (20).

On the "non phone line" side of the filter and power limit circuitry (20) is ringer sense circuitry (22). Ringer sense circuitry (22) ignores the nominal 45 volt DC "on hook" voltage and any audio component present on the phone line. The audio components that could be present are the dial tone, busy tone, and ringing tone. Ringer sense circuitry (22) will assert an isolated output to CPU U1 (14) when a nominal 90 volt DC "ring" signal is sensed on the phone line.

Also on the "non phone line" side of the filter and power limit circuitry (20) is one contact of a normally open "hook" relay (24). Hook relay (24) is controlled by a co-processor (COP) U2 (26), which will be discussed in greater detail below. On the other contact of hook relay (24) is an isolation

transformer (28), which is specified as an agency approved device for telephone line network interface. Isolation transformer (28) is designed to provide (i) electrical isolation between the telephone line and 5 peripheral circuitry, (ii) 600 Ω line impedance matching, and (iii) DC resistance ($\approx 110\Omega$) that is the major "off hook" resistance component of $<200\Omega$ as specified by the FCC. Isolation transformer (28) has a 1:1 turns ratio in this application.

10 The non phone line side of isolation transformer (28) is fed to clipper and filter circuitry (30), which limits voltage levels on this side of isolation transformer (28) to about 3 volts peak-to-peak. Excessive voltage spikes can occur on 15 activation of hook relay (24) while still ringing or just general line transients.

Transceiving data in the form of audio tones on a network designed for low fidelity voice transcription and data transfer rates of 9600 baud is a 20 complex process. The system (10) of the present invention specifically deals with the complexities of data telemetry on the telephone network via a fax/modem IC U3 (32) and COP U2 (26), which comprise a complimentary "chip set." COP U2 (26) works directly 25 with U3 (32) and contains pre-programmed conventional software specifically for phone line interface applications.

Fax/modem IC U3 (32) is connected to the 30 analog audio line by clipper and filter circuitry (30). U3 (32) is a programmable data converter requiring complex control and time sensitive

monitoring. U3 (32) is primarily a parallel data to data-tone converter and data-tone to parallel data converter, but also provides an audio output that represents what U3 (32) is transmitting at any 5 particular time. This signal is amplified by IC U12 (34) and associated circuitry and fed to a speaker (36) for a simple monitoring device. U3 (32) is programmable for various modes and different options depending on the application.

10 COP U2 (26) is pre-programmed with conventional software to handle the phone line arbitrations that occur when two "smart" devices are trying to communicate with each other -- in this case, the system (10) and a remote fax machine. COP U2 (26) 15 is controlled and monitored by CPU U1 (14) via an octal data buffer IC U6 (38) over direct access dedicated control lines in the system data bus. COP U2 (26) accepts a limited number of commands from CPU U1 (14) and takes over phone line communications from 20 there on.

COP U2 (26) can send an interrupt request to CPU U1 (14) if COP U2 (26) requires immediate attention. COP U2 (26) will thus deal with busy signals, ringing signals, dead air, retries, etc. 25 This prevents excessive processing time for CPU U1 (14). Thus, the U2/U3 (26, 32) chip set, under the control of CPU U1 (14) with conventional software code contained in a Read Only Memory (ROM) U4 (40), indirectly provides the gateway between the telephone 30 line and the fax data to be transmitted.

ROM U4 (40) is the "firmware" associated with the system (10) of the present invention. U4 (40) contains the program code for CPU U1 (14) to handle communications between the system (14) and an end device transmitting input data signals, as well as to handle control of the fax/modem chip set U2/U3 (26, 32). U4 (40) also contains fax control code to generate pre-defined fax forms, which provide tabulated or otherwise notational fields to place data variables provided by the input data signals in a logical and recognizable order.

The data variables are received by CPU U1 (14) of the system (10) via the aforementioned serial port (12) connected to an end device transmitting input data signals. The fax form format control code may be tailored to the specific application desired. Via CPU U1 (14), ROM U4 (40) and fax/modem chip set U2/U3 (26, 32), the system (10) thus generates a facsimile machine control signal operative to transmit the fax form including the data variables (from the input data signals) in response to input fax control commands or signals.

Standard static random access memory (RAM) U5 (42) is a volatile memory device that serves as a general purpose "scratchpad." RAM U5 (42) is used to store temporary variables in the form of real data and flag bits as CPU U1 (14) and associated conventional software dictate. U5 (42) is accessed by CPU U1 (14) on the data and address bus in a conventional manner.

IC U17 (44) is a latched control port that provides eight digital output lines to provide CPU U1

5 (14) with additional control. Various internal components and circuitry in system (10) must be under control of CPU U1 (14). These components or circuits must be activated or deactivated by CPU U1 (14) under certain conditions at the proper time via internal control bits, which come directly from CPU U1 (14) or COP U2 (26).

10 Referring finally to Figure 2, a block diagram of the data telemetry method of the present invention for use in conjunction with a facsimile machine is shown, denoted generally by reference numeral 50. As seen therein, the method (50) comprises receiving (52) an input control signal and a plurality of input data signals, each input data signal representing a pre-determined input parameter, and storing (54) a pre-defined fax form having a plurality of input parameter fields. The data telemetry method (50) of the present invention further comprises processing (56) the input data signals to incorporate the input parameters represented thereby into the input parameter fields of the fax form, and generating (58) a facsimile machine control signal operative to transmit the fax form via the facsimile machine in response to the input control signal.

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As is readily apparent from the foregoing description, the present invention provides an improved data telemetry system (10) and method (50) for use in conjunction with a facsimile machine. As is also readily apparent from the foregoing description, the data telemetry system (10) and method (50) of the present invention fill the need for a reliable and inexpensive data telemetry system and

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method that monitor remote site status and data, and relay such information to a central location.

5 In that regard, the data telemetry system (10) and method (50) of the present invention provide monitoring of remote sites to report messages on performance, conditions and errors either instantaneously, on demand, or periodically. In addition, the data telemetry system (10) and method (50) also relay such information to one or more 10 central location via a facsimile machine.

15 The data telemetry system (10) and method (50) of the present invention thus provide the well known monitoring and reporting advantages of traditional SCADA systems, thereby saving the costs associated with undetected equipment errors and out-of-range performance. At the same time, however, the data telemetry system (10) and method (50) also avoid the prohibitive costs associated with such traditional 20 SCADA systems and modified facsimile or fax/modem systems, thereby making continuous monitoring and reporting regarding remote locations available for more industrial applications.

25 It is to be understood that the data telemetry system (10) and method (50) of the present invention has been described in an illustrative manner and the terminology which has been used is intended to be in the nature of words of description rather than of limitation. Obviously, many modifications and variations of the present invention are possible in 30 light of the above teachings. Therefore, it is also to be understood that, within the scope of the

following claims, the present invention may be practiced otherwise than as specifically described.

Claims

1. A data telemetry system for use in conjunction with a facsimile machine, the system comprising:

5 means for receiving an input control signal and a plurality of input data signals, each input data signal representing a pre-determined input parameter;

means for storing a pre-defined fax form having a plurality of input parameter fields;

10 means for processing the input data signals to incorporate the input parameters represented thereby into the input parameter fields of the fax form;

15 means for generating a facsimile machine control signal operative to transmit the fax form via the facsimile machine in response to the input control signal.

2. A data telemetry system for use in conjunction with a facsimile machine, the system comprising:

20 a receiver for receiving an input control signal and a plurality of input data signals, each input data signal representing a pre-determined input parameter;

25 a memory for storing a pre-defined fax form having a plurality of input parameter fields;

30 a processor for processing the input data signals to incorporate the input parameters represented thereby into the input parameter fields of the fax form;

35 a facsimile machine control signal generator for generating a facsimile machine control signal

operative to transmit the fax form via the facsimile machine in response to the input control signal.

3. A data telemetry method for use in conjunction with a facsimile machine, the method comprising:

- 5 receiving an input control signal and a plurality of input data signals, each input data signal representing a pre-determined input parameter;
- 10 storing a pre-defined fax form having a plurality of input parameter fields;
- 15 processing the input data signals to incorporate the input parameters represented thereby into the input parameter fields of the fax form;
- generating a facsimile machine control signal operative to transmit the fax form via the facsimile machine in response to the input control signal.

2143387

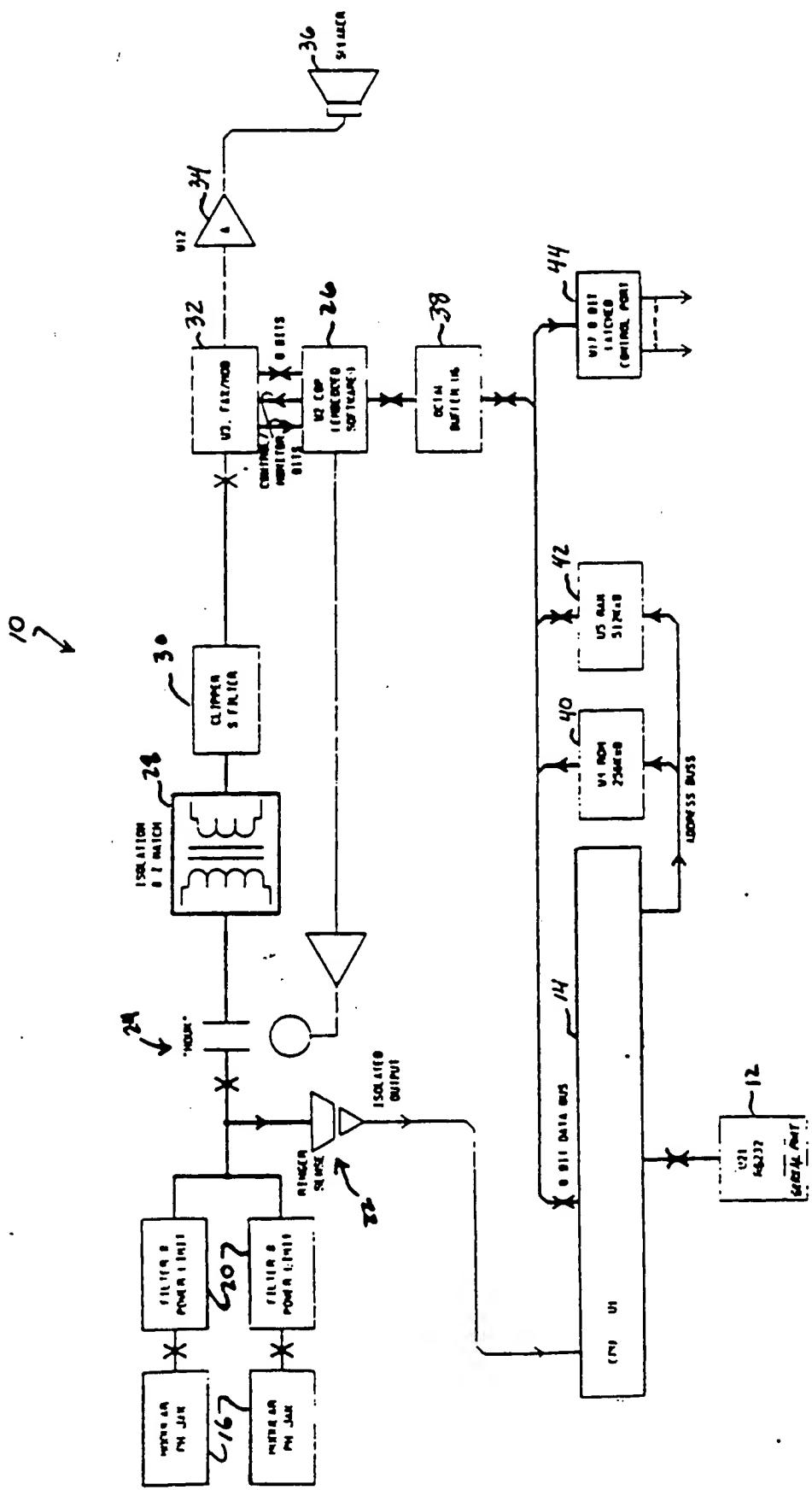


Fig. 1

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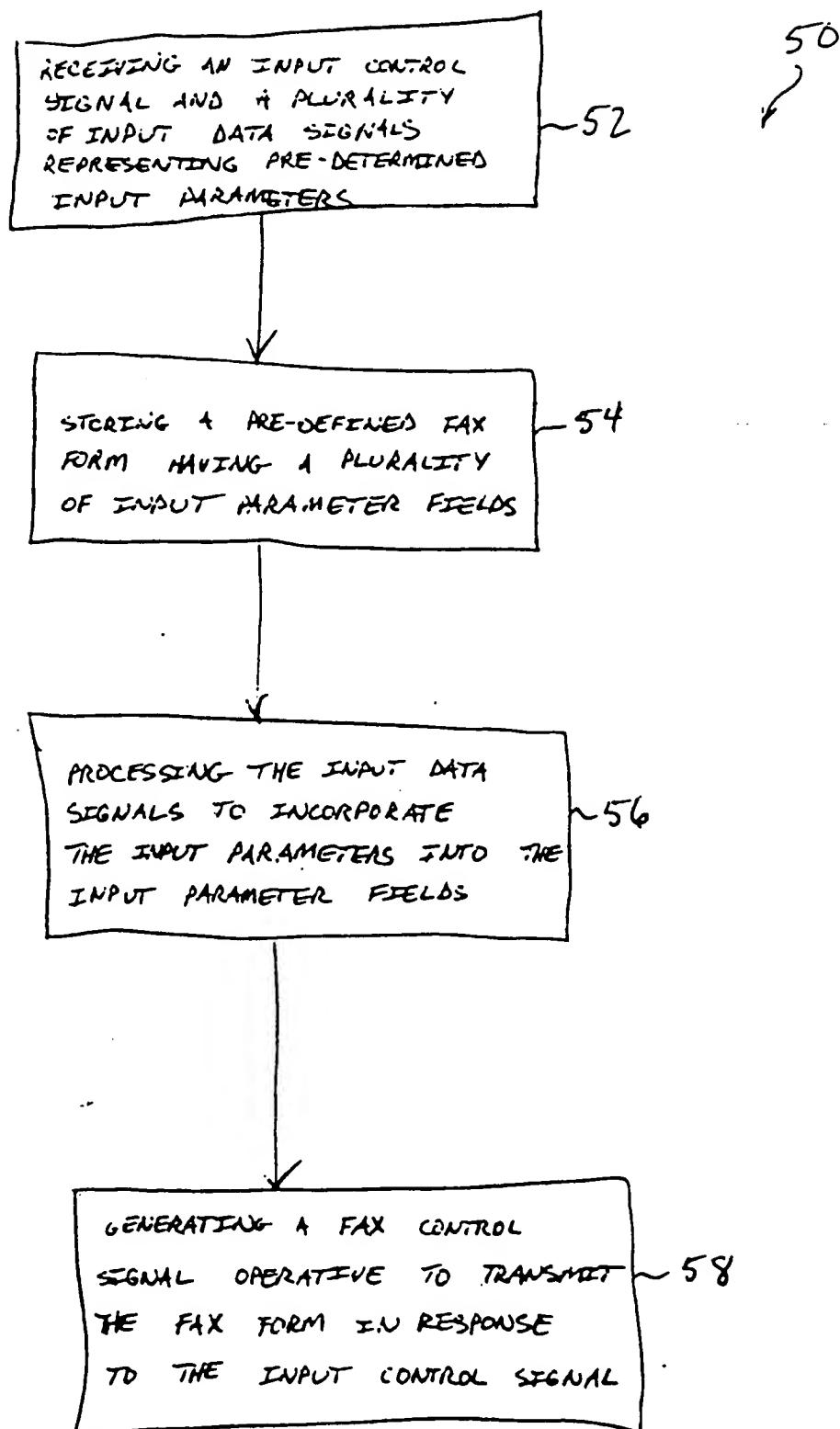


Fig. 2